



Escola de Camins
Escola Tècnica Superior d'Enginyeria de Camins, Canals i Ports
UPC BARCELONATECH

MY JOURNEY FROM A PHD TO A COMPANY

Cristian de Santos, PhD
CEO & Co-Founder
SAALG
GEOMECHANICS

PhD Day a l'Escola de Camins, April 15th 2026

THE BEGINNING



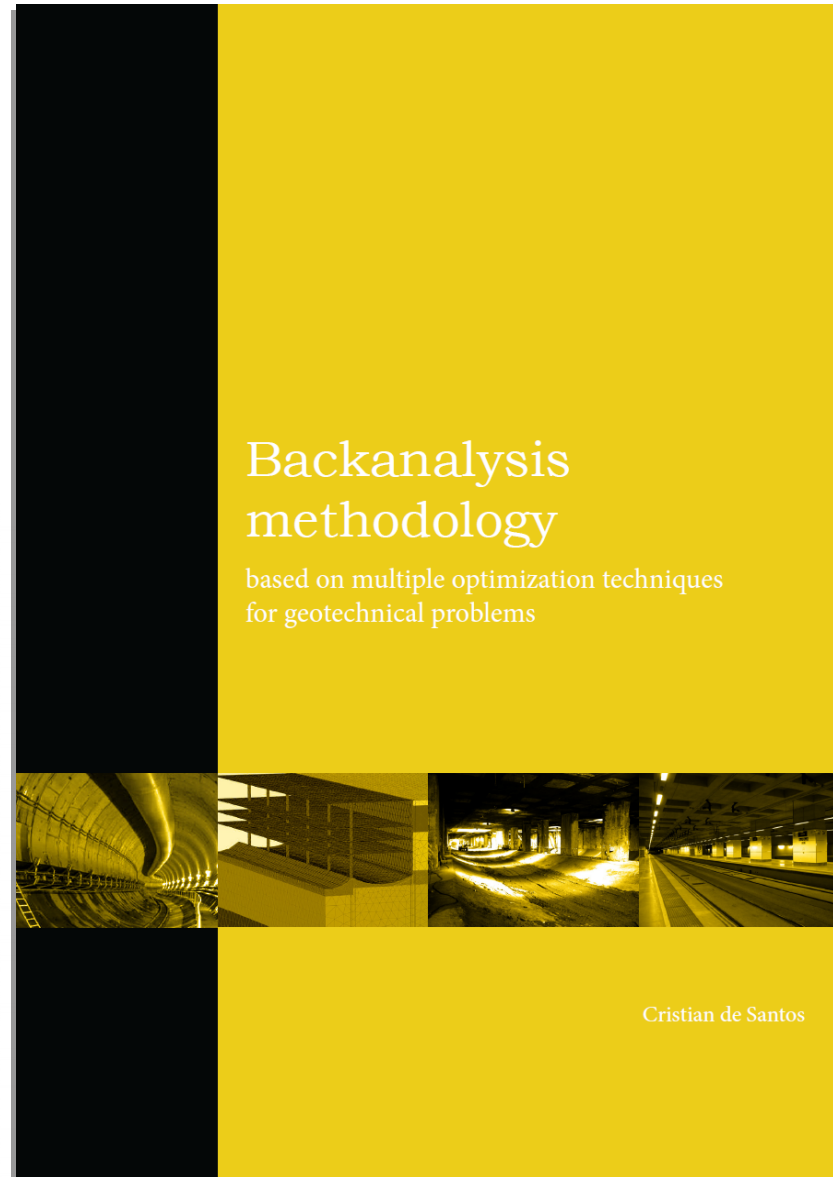
Deformaciones del revestimiento y asientos producidos por la construcción de un túnel mediante tuneladora

Autor: Cristian de Santos Rodríguez
Tutor: Eduardo Alonso Pérez de Agreda
Tutor externo: Nicola Della Valle
Código: 708-TES-EG-3212

Tesina de final de carrera
Ingeniería Geológica
Junio de 2007



MY THESIS





PROBLEM

GEOTECHNICAL UNCERTAINTY

“Not knowing how the ground behaves has a high environmental & financial cost to the construction industry and to society”

OVER-DIMENSIONED DESIGNS



UNFORESEEN EVENTS DURING CONSTRUCTION & MAINTENANCE



DELAYS



MALFUNCTION



FAILURE



PROBLEM

GEOTECHNICAL UNCERTAINTY

“Not knowing how the ground behaves has a high environmental & financial cost to the construction industry and to society”

**OVER-DIMENSIONED
DESIGNS**

≈ **1%**

of global CO2 emissions are caused by construction material consumption due to over-dimensioning

**UNFORESEEN EVENTS DURING
CONSTRUCTION &
MAINTENANCE**

22.5 B€

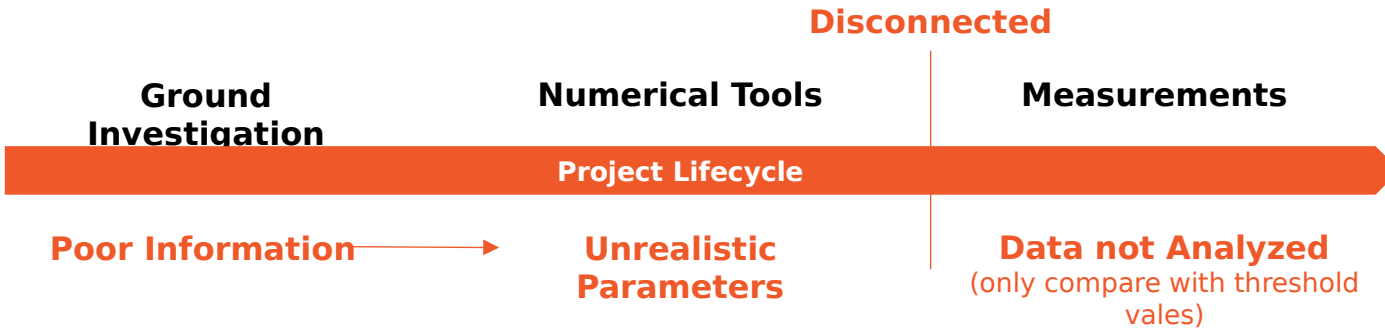
annual budget deviation caused by geotechnical uncertainties from the **top 50 European** construction companies (2015)



TRADITIONAL SOLUTION

HOW THE INDUSTRY TACKLES THE PROBLEM

- **INCREASE** ground investigation (during **pre-design**)
- **USE** sophisticated numerical tools (during **design**)
- **MEASURE** the real soil response (during **construction & exploitation**)



“The industry is **wasting** the **potential** of numerical tools and **missing** the high value of **analyzing** monitoring data”



BACKANALYSIS

THE METHODOLOGY

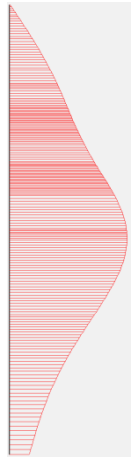
Measurements
s

$$J = \sum_{i=1}^m (x_i^* - x_i)^2$$

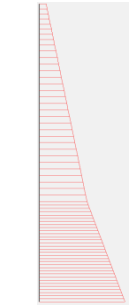
Computed with a model, i.e. F.E. Model

Depend on "p" parameters:

In Situ Measurements



Inclinometer

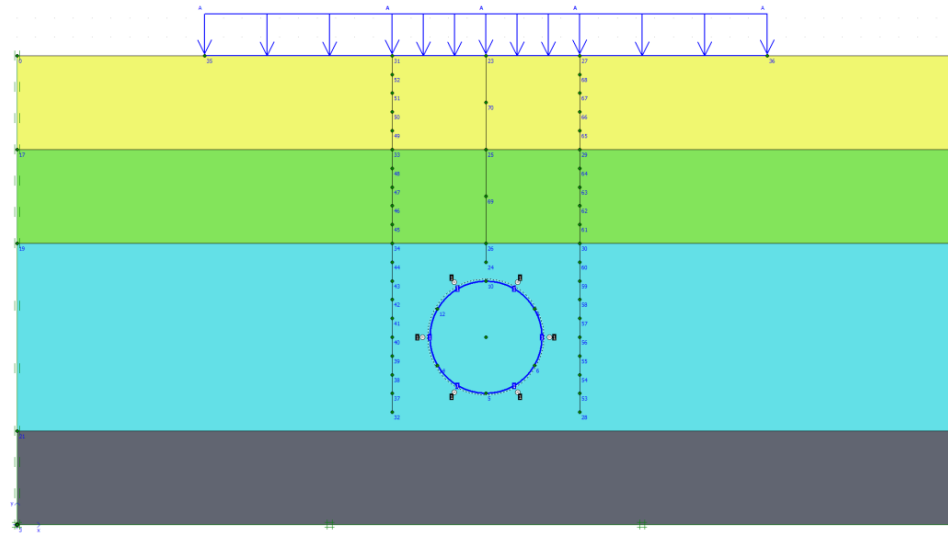


Sliding
Micrometer



Inclinometer

Calculations



AFTER 8 YEARS AND A HALF DOING RESEARCH

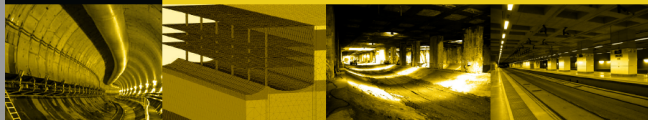
WHAT NEXT

THESIS

TECHNOLOGY

Backanalysis methodology

based on multiple optimization techniques for geotechnical problems



Cristian de Santos

A screenshot of the Microsoft Visual Studio IDE showing the source code for a project named 'TheTool_V2'. The code is written in C# and includes various data structures like arrays, vectors, and matrices, along with initialization logic and algorithmic steps. The Solution Explorer on the right shows the project structure with folders for 'Resource Files' and 'Source Files', and numerous files with extensions like '.F90', '.F99', and '.F97'. The Properties window at the bottom right is also visible.



SAMLG GEOMECHANICS

Shaping the future of a **smart, safe** and **sustainable** construction & mining industry.

WHERE GROUND MEETS
DIGITAL

PARTNER OF

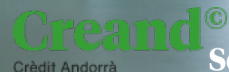


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VENTURES



Crédit Andorrà

Scalelab®

WHO WE ARE?

SAALG GEOMECHANICS

“We are a group of **passionate geotechnical engineers** and **software developers** delivering **digital solutions** into construction industry to make construction a more **sustainable, efficient, and safer** industry by reducing geotechnical uncertainty”

“We strongly believe a **better construction industry is possible**”

“We **don't want to be observers** of the digital transformation in construction, we **want to be part of it**”



WHO WE ARE?

SAALG GEOMECHANICS SHAREHOLDERS



Cement Company
Venture Capital



Engineering Firm
Venture Capital



Contractor
Venture Capital



Private & Public Institution
Tech Transfer / Venture
Builder



Bank
Investment Fund



Public Institution
Financial Institution

OTHER SAALG GEOMECHANICS SUPPORTERS



Software Company
Venture Capital - Open
Innovation



Accelerator
Juan Roig
Accelerator



Public Institution
Financial
Institution



Public Institution
Financial
Institution



WHO WE ARE?

INVESTING IN INNOVATION & DIGITAL SOLUTIONS

5 M€

“More than invested to develop and commercialize the solution to disrupt geotechnical engineering”



WHO TRUST ON US

SOME OF OUR CLIENTS

- ASSET OWNERS (Using DAARWIN to reduce risk)



- CONTRACTORS (Using DAARWIN to reduce cost)



- ENGINEERING FIRMS (Using DAARWIN to offer more and better services to their clients)



OUR SOLUTION:

DAARWIN

CONNECTING & CENTRALIZING EVERYTHING TO REDUCE GEOTECHNICAL UNCERTAINTY

BORING LOG

Depth (m)	Color	Geological Formation / Soil Name	Description	Standard Penetration Test	Sampling / Field Test
0.00 - 0.30	Yellowish Brown	Fill (Sandy Silt / Clayey Silt etc.)	Med Water Content, nonhomogeneous, Fill - Firm Low Plasticity, Sandy Silt / Clayey Silt mix with broken Concrete Debris, heavy Gravel etc.	70 49 09 80	
0.30 - 0.60	Yellowish / Reddish Brown to Dark Brown to Black	Fill (Sandy Clay etc.)	Material is Nonhomogeneous Fill - Medium Water Content, Medium to High Plasticity; Silt Fine Grained Sandy Clay and mixed with Black Colored Organic Matter from decomposed Wooden Material at Lower Part with distinctive smell.		
0.60 - 1.00	Dark Gray	Very Soft Sandy Clay (Aluvium)	Med to high VIC High Plasticity Very Soft Fine Grained Sandy Clay with some Organic Matter		
1.00 - 1.30	Greenish Gray	Very Soft Marine Clay (Aluvium)	High VIC High Plasticity Normally Consolidated Very Soft Marine Clay & some Organic Matter from decayed vegetation		
1.30 - 1.60	Dark Gray	Very Soft Sandy Clay (Aluvium)	Medium Natural Water Content, High Plasticity, Normally Consolidated, Med Compressibility, Very Soft Sandy Clay with Fine Grained Sand		
1.60 - 1.90	Reddish / Yellowish Brown	Soft Brown Clay (Aluvium)	Nonhomogeneous, Low to Medium Water Content, High Plasticity, Low Permeability, Normally Consolidated, Soft Brown Clay with Rusted Structure and Yellowish Brown Colored Mottles		
1.90 - 2.20	Reddish Brown to Whitish Gray	Firm Brown Clay (Aluvium)	Low VIC, High Plasticity, High Stiffness, Low Permeability, Normally Consolidated, Nonhomogeneous, Firm, Brown Clay with some Fine Grained Sandy Clay at Lower Part		
2.20 - 2.50	Light Brown				
2.50 - 2.80	Light Yellow to Yellowish Brown to Mottled Brownish Yellow				
2.80 - 3.10	Light Brownish Gray				
3.10 - 3.40	Light Gray to Mottled Yellowish Brown				

Sensitivity Plot

Sensitivity Results

Geotechnical Profiles

Backanalysis Plot

- Original Design
- Calibrated Design
- Monitoring Data
- Optimal Option



OUR SOLUTION: DAARWIN

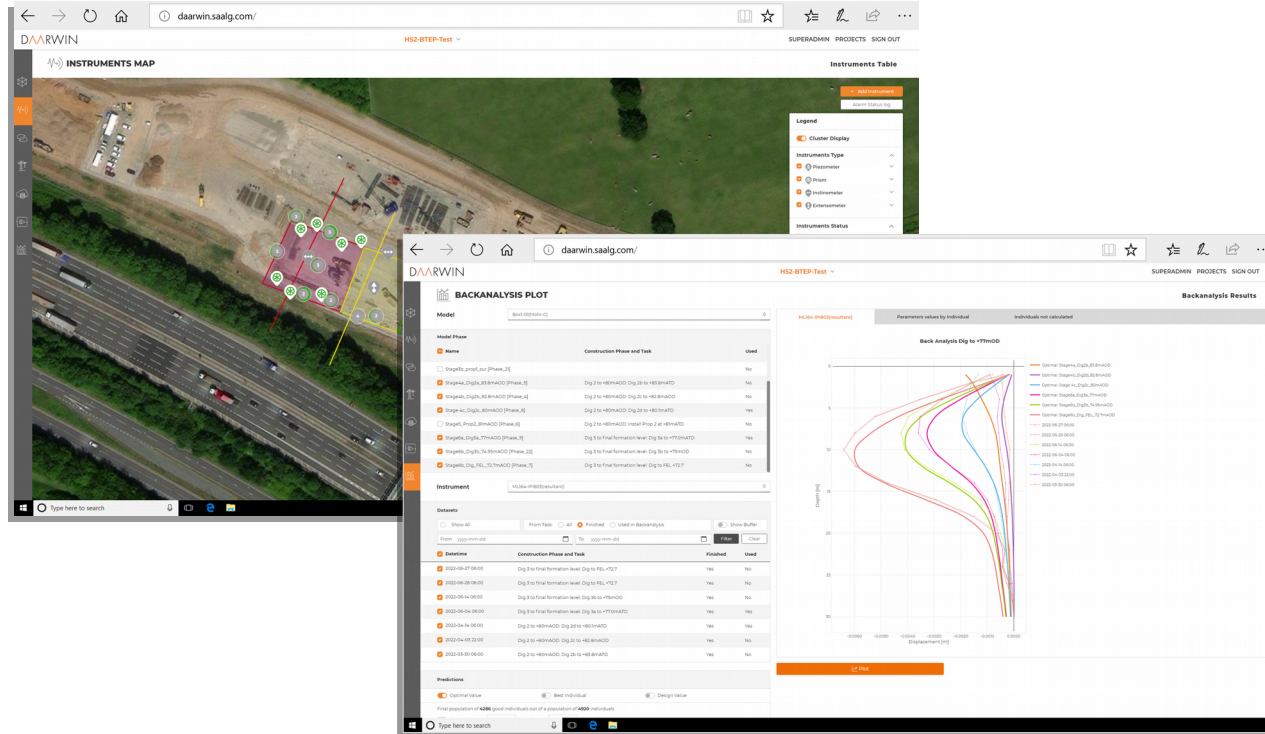
DAARWIN KEY FEATURES

- **Public Ground Information System**
*Streamlining Access to **Public** Geotechnical Data for Smarter Project Planning*
- **Digitalization Tool**
*Transforming Legacy Data into Actionable **Digital Insights***
- **Private Ground Investigation Data Management Tool**
*Building a Full Digital **Ground Model***
- **High-Performance Cloud Computing for Sensitivity & Backanalysis**
*Understanding **Parameter Influence** for Smarter Design Decisions & Dynamic Calibration to Characterize Ground Conditions and **Predict Real Ground Behavior***
- **I&M (Instrumentation & Monitoring) Data Management Tool**
Streamlining Monitoring Data for Smarter Decision
- **TBM (Tunnel Boring Machine) Data Management Tool**
*Enhancing Tunnel **Excavation Efficiency** with Real-Time Insights*
- **Rock Image Characterization Tool**
*Leveraging **Images** to Understand **Rock Mass Conditions***



CASE STUDY

BROMFORD TUNNEL EAST PORTAL, UK



- The benefits of **DAARWIN** were quantify with **4 months** program reduction, **£2.8M** cost savings, and **3000 tCO2e** saving.

[Digital innovation is enhancing the observational method on HS2 | Mott MacDonald](#)



CASE STUDY

MULARROYA HIDRAULIC TUNNEL, SPAIN

- TBM excavation **PERFORMANCE INCREASE:**
12.5%
- TBM excavation **TIME REDUCTION:** **14 days**
- **COST savings:** **1.5 M€**
- **CO2 emissions REDUCTION:** **140K tCO2e***

For more details go [ATC 2023 Papers V3.pdf \(dropbox.com\)](#) to:

*Equivalent to the annual CO2 emissions of **28,000 cars** (average petrol cars emissions running 20,000 kilometers per year)



THANK YOU FOR YOUR ATTENTION

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WHERE GROUND MEETS **DIGITAL**

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